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ABSTRACT

This report reviews and compares the impact of university support policies in Ontario to those of Quebec, Alberta, and British Columbia and proposes a framework to regenerate the research infrastructure of Ontario universities. It identifies erosion in Ontario's comparative and competitive position within Canada though Ontario still performs about 40 percent of Canada's university research. Specific trends in research capacity are analyzed for sponsored research, funding and grants of the National Sciences and Engineering Research Council, Medical Research Council funding, Social Sciences and Humanities Research Council funding, sponsored research by academic staff, and provincial share of PhDs granted. Major challenges are identified in the areas of research infrastructure, federal and provincial responsibilities, the nurturing of new researchers, and finding the balance between publicly and privately supported research. The proposed framework for the Ontario Government urges: (1) a formal policy statement recognizing the research mission of universities; (2) explicit support for research infrastructure; (3) efforts to attract and retain new faculty; (4) the harnessing of university expertise for socioeconomic development; (5) complementarity of Ontario efforts with those of the federal government; and (6) development of Ontario universities as a network of complementary institutions. A summary of the research policies in Quebec, British Columbia, Alberta, and Ontario is included. (JLS)

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ED 403 848

THE IMPACT OF PROVINCIAL POLICIES ON UNIVERSITY RESEARCH

A COMPARATIVE STUDY OF SELECTED CANADIAN PROVINCES

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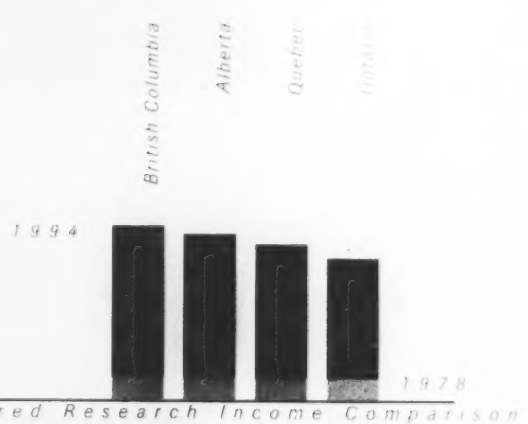

Sponsored Research Income Comparison

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THE IMPACT OF PROVINCIAL POLICIES ON UNIVERSITY RESEARCH

A COMPARATIVE STUDY OF SELECTED CANADIAN PROVINCES

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Cover illustration is Figure 2: Sponsored Research (Federal Sources).

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For summaries of research policy developments in the four provinces and trends in research capability, consult the separate Appendix. To obtain a copy, please contact COU Public Affairs at 444 Yonge Street, Suite 203, Toronto, Ontario M5B 2H4 and/or call (416) 979-2165 ext. 236.

A Comparative Study of the Impact of Provincial Policies on University Research in Selected Canadian Provinces

1. INTRODUCTION

This report was commissioned by the Council of Ontario Universities to review the impact of university research support policies in several provinces in Canada. Selected for comparative study with Ontario were Québec, Alberta and British Columbia, since the development of university research in these provinces over the last two decades has exceeded the Canadian average.

To measure the impact of policies on research capabilities, it was necessary to gather information on both policies and research capabilities over a reasonable period of time. The first part of this study features selected specific policies on research capabilities for review and analysis.

The second part — ideally to involve measuring and comparing research capability over time — presented a difficult task because of the limited, three-month time frame for completion of this report and because only the indicators for which reasonable information already existed could be selected. Data analysis by itself was not sufficient for drawing reasonable conclusions on the state of university research in Ontario and other provinces. To obtain a more balanced perspective, highly knowledgeable individuals in each province were interviewed for their opinion on the effectiveness and impact of provincial support policies on university research.

This paper presents a summary of the findings in each province, followed by an analysis of trends in research capability.

2. A REVIEW OF PROVINCIAL POLICIES

2.1 Québec

Québec has had structured scientific development policies for more than 25 years. These policies were initiated in the '70s, shortly after the "quiet revolution," when Québec realized that a strong science base was essential to both cultural and economic development. At that time, Québec's scientific capacity was lagging behind that of Ontario and many other provinces. Medical research was strong, but science and engineering were underdeveloped except at McGill University.

During the first 10 to 15 years after Québec's science policy was initiated, universities were the main instrument of research development. This policy was based on the logical conclusion that the first step in the process should be the development of an adequate pool of highly qualified research personnel. To this end, Québec created three full-fledged granting councils — FCAR (Formation de chercheurs et actions concertée, FRSQ (Fonds de recherche en santé du Québec) and CQRS (Conseil québécois de la recherche sociale). In an effort to build critical mass in the various disciplines and to ensure complementarity with federal granting councils, these councils have promoted *team* research as opposed to *individual* research, encouraging universities to focus their research (and recruitment) efforts in areas where they already had core strengths. An obvious benefit of this emphasis on building on strengths is that Québec universities have been able to obtain more funding from granting councils, thus leveraging federal funds on the basis of excellence; it is reasonable to conclude that, by promoting collaboration and teamwork as a means to build on its strengths, Québec gave its researchers a competitive edge.

In some quarters, there is disappointment that while the focus on developing university research has strengthened the science base, it has not had a sufficient impact on economic development and industrial innovation. In retrospect, it was realized that support for university research and training per se is not sufficient to promote innovation. Both the academic community and the private sector need incentives to work together. Such incentives have been created in the past decade and more importance has been placed upon partnerships and transfer mechanisms. New structures and mechanisms have evolved, generally outside granting councils, to promote collaboration. Research is planned and conducted jointly, and is assessed not only by peers but also by boards of directors that scrutinize relevance in addition to excellence. Instead of Centres of Excellence, Québec created "hybrid" organizations with a mandate for liaison and transfer. Early evaluations recommended continued funding for all but two of these organizations, although little has been done, as yet, to document "success stories."

In addition, fiscal incentives for private investment in R&D opened the door for the funding of large university projects by investors. Largely because of these incentives, private funding of university R&D in Québec jumped to $231 million in 1992-93 (from $80 million in 1982-83). This funding, however, is starting to decline, now that some of the incentives have disappeared.

The Québec Government, like the federal government and most other provincial governments, has had numerous administrative and political structures for overseeing or coordinating higher education and science and technology (S&T). At present, responsibility for S&T lies with the Ministry of Industry, Commerce, Science and Technology. For most of the past 25 years, science has been linked to higher education. Because of the Ministry of Education's interest in research and its explicit recognition of research as an essential tool of human resources development, universities were positioned at the forefront of science policy-making. At

present, FCAR and the Indirect Cost Envelope are the two major instruments of university research support through the Ministry of Education.

Section 1 of the Appendix presents a chronology of events as well as a brief description of some policies and programs that include the following:

- Start-up grants for new faculty members.
- Actions structurantes, a program that had some similarities with the university research fellowships of the Natural Sciences and Engineering Research Council (NSERC).
- Centres de liaison et de transfert, a mechanism which Québec uses for fostering university-industry interaction instead of Centres of Excellence or Networks of Centres of Excellence.

This section of the Appendix also includes a description of the funding formula for operating grants, in particular, the Indirect Cost Envelope, which was created in 1989-90. This Envelope is based on peer-reviewed grants from approved government and philanthropic organizations. The formula rate is 10% for biomedical research and 15% for other disciplines. As is the case in Ontario, the amount is based on a three-year moving average, slipped two years. In 1995-96, the Envelope was $37.6 million.

A recent "Avis" from the Conseil supérieur de l'Éducation recommends that the government clearly spell out a policy for university teaching and research and that the funding formula be a logical outcome of the objectives of that policy. As is the case in Ontario, there is serious discussion regarding the balance between taxpayers' contributions and those of students and other stakeholders. Accountability and openness are recurring themes.

There is some pessimism in Québec regarding the ability of universities to sustain the research enterprise, given the inability of several institutions to come to grips with priorities rather than making across-the-board cuts. The *rattrapage*, or "catching-up," may be complete, but the edifice is fragile.

2.2 British Columbia

In British Columbia, as elsewhere in Canada, provincial operating grants to universities, called General Purpose Grants, provide the bulk of research infrastructure funding in that they fund the salaries of academic staff engaged in research and support the operation and maintenance of physical plant.

There was no real change in the allocation formula until 1989. At that time, the universities agreed that the formula constituted an equitable base upon which to build other allocation mechanisms. In 1989, the Ministry of Education contracted with the universities to provide additional enrolments at average cost. As some universities grew more than others, their share of the grants increased as well. In 1992, the universities and the government contracted

with Dr. Stefan Dupré, now President of the Canadian Institute of Advanced Research, to conduct an equity study of provincial grants. He concluded that generally the grants were equitably distributed. He called, however, for the establishment of eight Funding Envelopes, one of which was identified as a Research Overhead Envelope. The Ministry has not acted upon this recommendation. With the recent introduction of a Research Excellence Envelope in Alberta, British Columbia remains the only one of the four provinces studied in this report that does not allocate part of university funding on the basis of sponsored research. One notable exception is the provision of infrastructure support for federal Networks of Excellence, through Technology B.C.: During the first round of the program, the province provided 50¢ for each federal dollar; this amount is now down to about 25¢.

British Columbia has relatively fewer university professors per capita than most other provinces, partly because its population is growing faster in comparison. It is also the province with the lowest proportion of its population attending university. To increase accessibility, the B.C. Government in recent years has not only increased the number of universities, but has also ensured that the university funding formula rewards increased enrolment. As a result, provincial funding of universities has increased somewhat more than in other provinces since 1989. (The growth of funding was slowest between 1983 and 1989.)

This push for accessibility and the absence of a Research Infrastructure Envelope, however, have not weakened the research excellence of university professors in B.C. since its universities — in particular, the University of British Columbia — stand out in terms of success in national research grant competitions. Since 1983, academic staff in the province have received more federal government research funding than their counterparts in other provinces. This fact can be partially attributed to the ability of B.C. researchers to take the lead in major national projects such as Lithoprobe and the Networks of Centres of Excellence.

Undoubtedly, the remarkable progress of B.C. universities in research is due to the quality of academic staff. But since it takes a long time to develop a high-quality research enterprise, part of the '60s and '70s success is also due to policies and programs that encouraged universities to develop research and to recruit and retain excellent academic staff. Observers of the university research scene in British Columbia believe that policies introduced by Dr. Pat McGeer, a University of British Columbia professor who became Minister of Education and Science, served as a catalyst for research development from the mid '70s to the early '80s. This era saw the creation of the Science Council of British Columbia (SCBC) and the Advanced Systems Institute, as well as the provision of land for Discovery Parks and reasonable capital funding for the expansion and development of research facilities.

Another incentive to research development is the Fund for Excellence in Education program, set up in the mid '80s, a time when, unlike other universities in Canada, universities in B.C. were recruiting. It was an advantage that enabled them to attract the excellent researchers who are so successful today, some of whom were recruited from Ontario universities.

As in other Canadian provinces, British Columbia has programs that support health and biomedical research. The vehicle for supporting this field is the British Columbia Health Research Foundation (BCHRF). Its programs are designed to support health research and human resource development in areas that address priority health issues in the province.

British Columbia has had a formal S&T policy since 1988. It was developed by the Premier's Advisory Council on Science and Technology (PACST), which was created in 1987 to provide the Premier with advice on all matters relating to S&T. Responsibility for development, implementation and coordination of the policy lies with the Science and Technology Branch of the Ministry of Employment and Investment. (Prior to the creation of this new Ministry in 1993, the unit was a division of the Ministry of Advanced Education, Training and Technology.)

The Science Council of British Columbia (SCBC), an agency under the purview of the Minister of Employment and Investment, is a major instrument for delivering the S&T policy and is a key player in supporting targeted university research and training. SCBC was created in 1978 with the dual mandate of delivering programs and providing advice; the latter part of the mandate was subsequently assumed by PACST.

British Columbia's S&T policy formally views research, science and technology as instruments of economic development and recognizes the role of postsecondary institutions in applied research and technology transfer. This policy translates into several programs in support of S&T development and also includes a strong "public awareness" component as well as a high-profile awards program administered by SCBC.

The programs in British Columbia which affect its universities include the following:

- Infrastructure and administrative support for Networks of Centres of Excellence, amounting to $1.7 million, which is distributed annually to the approximately 26 participating groups in the province.

- Technology B.C., which has a program supporting applied R&D. It also supports industrial R&D, encourages university-industry interaction and promotes transfer of research to industry. Its budget, which has fluctuated over the years, was $8.1 million in 1994-95.

- Support of university-industry liaison offices.

- Support for the Advanced Systems Institute, an organization which encourages universities and other postsecondary education institutions to work with industry in the area of information systems, telecommunications, micro-electronics and robotics.

Most of these programs are modest in size but involve joint funding with the private sector or the federal government, thus leveraging funds from other sources.

According to Statistics Canada, direct provincial support of university research (excluding research infrastructure provided through the Ministry of Education, Skills and Training) in 1994 was slightly more than $17 million (including support for health research), down from $20 million a few years earlier. As a result, provincially sponsored research support in 1994 represented only 9.5% of total sponsored research funding, compared to 20% in Alberta and Québec and 16% in Ontario. It should be noted that indirect support, such as capital funding and seed money for new programs, is not included in these figures, which likely means the extent of provincial funding for research is underestimated. Another source of funding in the last two years is Forest Renewal B.C., which has started to invest heavily in university research.

In British Columbia, provincial support for research has paid remarkable dividends. At present, most of this support comes from agencies or entities outside the Ministry of Education and Training, for which research — and, to a point, graduate studies — is not a major concern. In the absence of operating funds earmarked for research overhead, universities find it increasingly difficult to provide the infrastructure support needed to sustain research funded by the federal granting councils. However, most observers of the research scene agree that B.C.'s research infrastructure is in better shape than that in Ontario or Atlantic Canada.

Section 2 of the Appendix presents a more detailed report of the evolution of policies and programs in British Columbia.

2.3 Alberta

Alberta's policies and programs have gone through major changes in recent years, as the province embarked on a major deficit-cutting exercise forcing agencies and institutions to reduce costs after several years of relatively strong funding, compared to most other Canadian jurisdictions.

The field of science and research has not been exempt from these deficit-cutting exercises. Science is now the main responsibility of the Alberta Science and Research Authority (ASRA), created in late 1994. ASRA's first priority was to determine the feasibility of consolidating the various research-oriented agencies, boards and commissions of the Alberta Government. This consolidating process is almost complete, and several organizations have either disappeared or been merged in the last year. Public consultations are under way for determining the province's research priorities. The obvious result is a "healthy" tension between the line departments and ASRA, given that part of line ministers' budgets is now subject to review by another entity and that provincial investment in S&T has been dropping

significantly in recent years. Conclusions on ASRA's success have yet to be drawn, and the next year will be crucial in determining whether such a model works.

About one-third of the provincial government's R&D expenditures is invested in university research. This is done mostly through the Alberta Heritage Foundation for Medical Research and through other ministries and agencies, such as Agriculture or Energy. The Department of Economic Development and Tourism is also involved, especially in promoting partnerships between universities and the private sector. It is, however, experiencing severe downsizing as this report is being finalized. As in other provinces, research infrastructure in Alberta is also provided to universities through operating grants from the Department of Advanced Education and Career Development.

Not unlike the situation that prevailed in Ontario until the mid '80s, the Department of Advanced Education and Career Development (AECD) and its previous incarnations had never explicitly recognized university research. The government's request that all departments clearly define their mission triggered AECD's interest in clarifying its role. AECD commissioned a consultative study of the state of university research. This study was conducted in 1995 by Dr. Gilles Cloutier, past Rector of the Université de Montréal and former President of the Alberta Research Council. The Cloutier report presents the results of a province-wide consultation which revealed the following:

- Recruiting and retaining excellent researchers is becoming a serious problem.
- Alberta universities are losing ground in the competition with other major research universities in Canada.
- There is a drastic reduction in infrastructure resources.
- The indirect costs of research may be eroding resources for the teaching infrastructure.

The report concludes that these problems are serious and that something should be done. One of its most significant recommendations stresses the need to recognize the fact that university research exists and that it needs a voice at the Cabinet table.

This recommendation, among others, was accepted by the government, and a policy framework entitled "Fostering Excellence" was adopted in 1996. This policy framework addresses many of the Cloutier report's concerns. Among other initiatives, it advocates the following:

- Provide $6 million over the next three years to help newly recruited researchers.
- Emphasize public accountability, establishing measures of quality and relevance for university research. Since the funding formula will be partly based on performance in the

future, indicators of research performance are being developed, including research intensity (sponsored research as a fraction of operating budget); research graduate student enrolment and graduate student awards; publications and their impact (such as citations); funding from granting councils; private funding of research; licensing revenues; and invention disclosures.

AECD has also spelled out its expectations of university research, with the universities expected to:

- reinforce areas of excellence or strength;
- increase partnerships and strategic alliances;
- strive for quality in both research and teaching; and
- be accountable and responsive.

Section 3 of the Appendix presents a summary of the evolution of policies and programs in Alberta.

2.4 Ontario in Comparison with Other Provinces

The Ontario Government, like the federal government and the governments of most other provinces, has had numerous political and administrative structures responsible for funding (or coordinating) higher education, innovation and technology. Responsibility for science, research, innovation and technology has been transferred from Cabinet Office, to Natural Resources, to Premier's Council and to successive incarnations of the Ministry of Industry or Economic Development, with some sharing of responsibility with Education and line departments. (See Section 4 of the Appendix for a historical summary and brief program descriptions.)

Prior to the mid '80s, the various predecessors of the Ministry of Education and Training were not very active in explicitly promoting university research and scientific development. Yet, university research flourished in Ontario. It was relatively well funded by the federal granting councils. The operating grants formula, through its differential weights for graduate students, helped pay for the expansion of graduate studies and the indirect costs of research, and capital funding was available for expansion of research space.

Federal policies were serving Ontario well, thus greatly contributing to the development of a strong research infrastructure in the province. In the absence of financial constraints, explicit policies on university research development were not needed at the provincial level.

The turning point for infrastructure funding came in the early '80s, when both enrolment and sponsored research funding, especially from the federal government, grew at a much faster pace than operating grants funding (largely due to changes in federal-provincial arrangements for the funding of higher education). This raised fears that the capacity to sustain the growing

research enterprise was deteriorating. Numerous federal and Ontario commissions recommended that the federal government pay the indirect costs of the research it supported.

When it became evident that the federal government would not move in this direction, the Ontario Government introduced the Research Infrastructure Envelope, at that time pegged at almost 15% of federal granting-council funding (based on the average of the previous three years). The percentage decreased to 12.4% in 1994-95. In contrast, Québec's Research Infrastructure Envelope, created at about the same time as Ontario's, continued to grow in proportion to growth in external funding. It should be noted, however, that comparison of infrastructure funding is difficult, given the different weights assigned to graduate students in the two provinces and the fact that both provinces have been discounting enrolment for years to match the available funding.

Given the strength of university R&D in Canada and the weak industrial R&D base, university-industry interaction became a priority for all levels of government, including Ontario, which developed innovation policies and programs starting in 1984. The flagship programs for universities were the Ontario Centres of Excellence and the University Research Incentive Fund (URIF).

In contrast with Québec programs, which were created to complement federal programs, URIF shares many of the characteristics of NSERC's Research Partnerships Programs which were established at about the same time (notably, the Cooperative R&D grants spun off from the much older PRAI grants). URIF was also more attractive to universities because both the direct and indirect costs of research were eligible. The program was also very successful in fostering lasting university-industry cooperation, although it is doubtful that URIF contributed to attracting federal research funds.

The Ontario Centres of Excellence program is not comparable to those of other provinces, which are of a much smaller scale and, for the most part, which were not selected through a peer-review process. The federal Networks of Centres of Excellence program was modelled on the Ontario program. The major differences are that the Networks of Excellence involve more extensive networking and do not provide the indirect costs of research.

All provinces and the federal government have had policies and programs to foster university-industry interaction and technology transfer. Many models exist and most appear to work relatively well, although the "ideal" mechanism has not yet been discovered. Key individuals interviewed for this study believe that success at effectively transferring research results depends more on university policies and on the involvement of individuals with the right mix of skills rather than on provincial or federal programs. As a result, it appears that there are no major differences among the provinces — each province studied has some universities that are active and successful at bringing research results to the users of that research.

This report did not consider biomedical research in detail. All provinces have programs supporting health research as well as successful health-research institutes (funded mostly by private sources) conducting world-class research. In Ontario, the research infrastructure for biomedical research seems more secure than in other disciplines. At the present time, there are no significant differences among the provinces in terms of research infrastructure and research support, except for one: While in other provinces, "arm's-length" agencies are responsible for supporting health and biomedical research, in Ontario — except for a number of government-funded foundations — research is funded directly by the Ministry of Health.

3. TRENDS IN KEY INDICATORS OF RESEARCH CAPACITY

Indicators of research impact are still under development in this country and beyond, in other countries. Several provincial governments, granting councils and university associations are involved in the development initiative, but the task is not complete. In the past, what was used were mostly input indicators — e.g., enrolment and sponsored research income. Some output indicators are also used — e.g., higher degrees conferred and, more recently, statistical studies based mainly on citation analysis. The economic impact of university research is not well documented, although anecdotal evidence abounds.

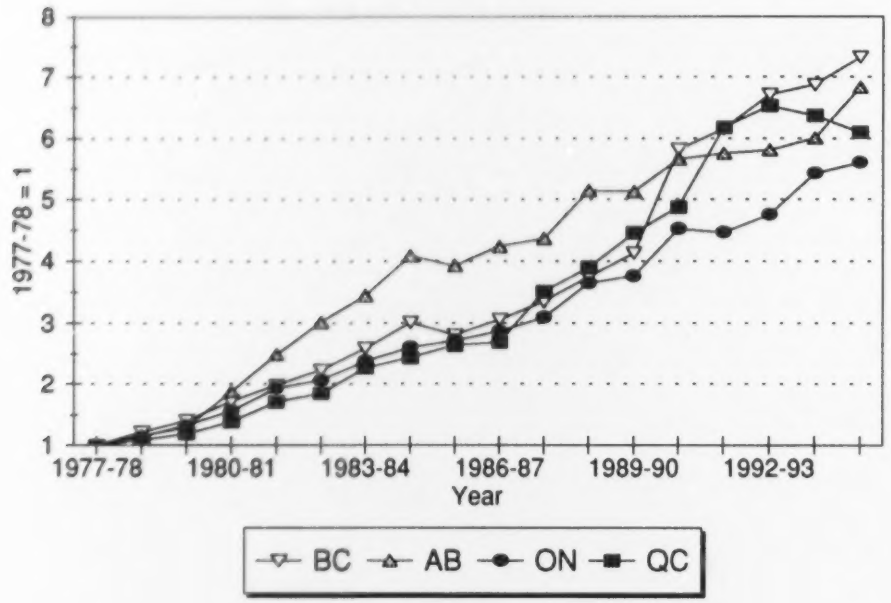
Publications, citations, patents, licensing agreements and spin-off companies are major indicators of research quality and relevance. However, the time frame of this study was too short to conduct a comparative review of research output. Sponsored-research funding had to be used as a proxy, since quality and relevance of research are major peer-review criteria.

Figure 1 shows that total sponsored-research income increased more than sixfold in British Columbia, Québec and Alberta, and fivefold in Ontario. Growth in Alberta was much higher in earlier years with the introduction of the Alberta Heritage Foundation for Medical Research. Since 1988-89, however, Alberta has had, by far, the slowest growth. On the bright side, private sector funding has grown steadily in the last decade and accounts for the recent relatively high growth in Ontario and Québec.

Figure 2 shows that sponsored-research income from federal sources grew at a more rapid rate in British Columbia than anywhere else, with a sudden jump in 1990. Of the four provinces, Ontario has the lowest funding growth, based on the Canadian average. Prior to 1985, most provinces grew at roughly the same rate.

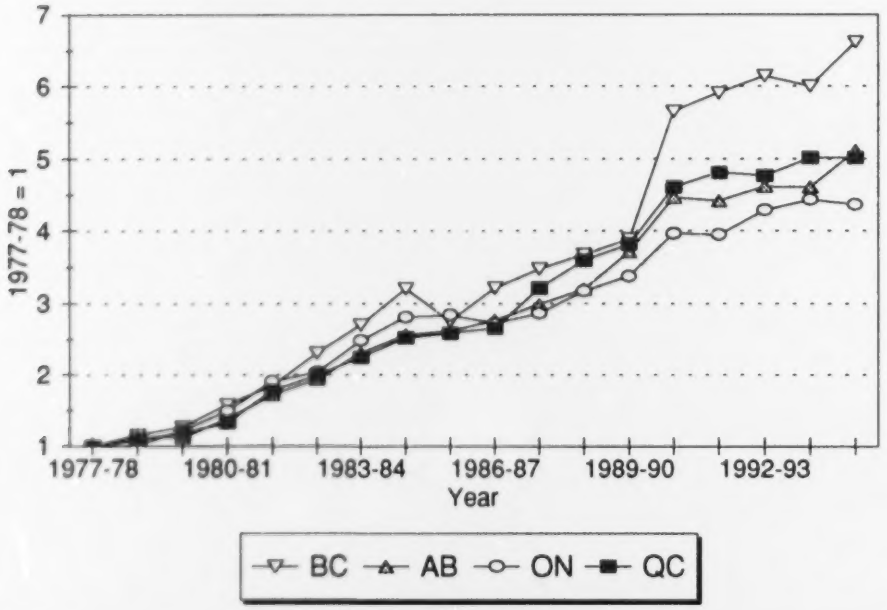
Sponsored Research Income

Figure 1



Sponsored Research (Federal Sources)

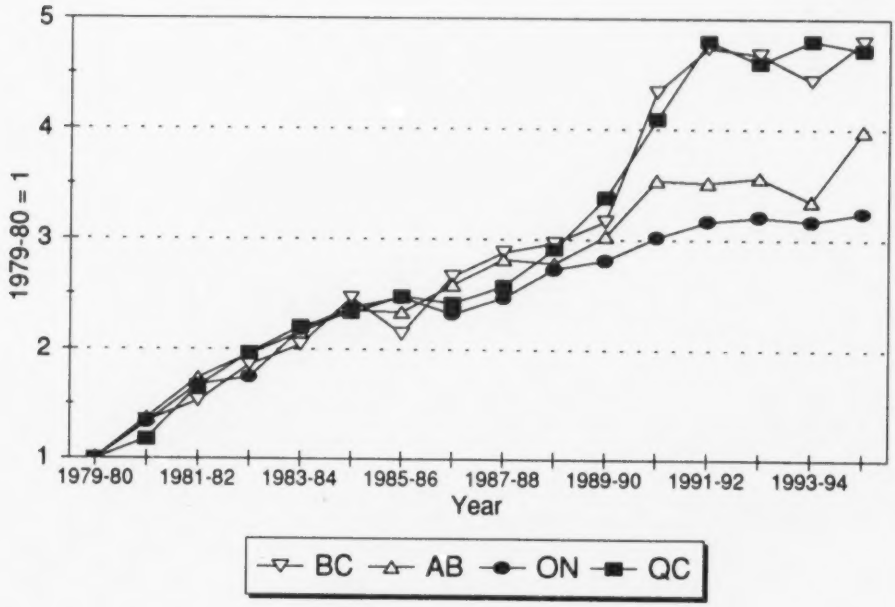
Figure 2



NSERC is the largest single funder of university research in most provinces. **Figure 3** shows the tremendous growth of NSERC funding in Québec and British Columbia, compared to that of Ontario. Still, Ontario remains by far the largest recipient of NSERC grants, its share amounting to $141.5 million, or 35.3% of NSERC total grant money. In 1979-80, however, Ontario's percentage was 44%. **Figure 4** shows how Ontario's share of NSERC research grants has decreased over the last decade.

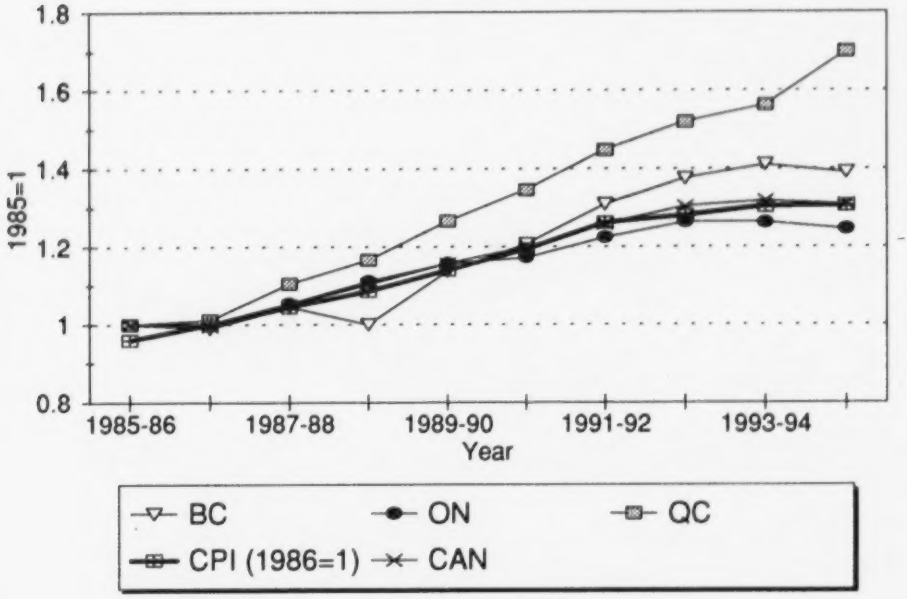
NSERC Funding

Figure 3



NSERC Research Grants

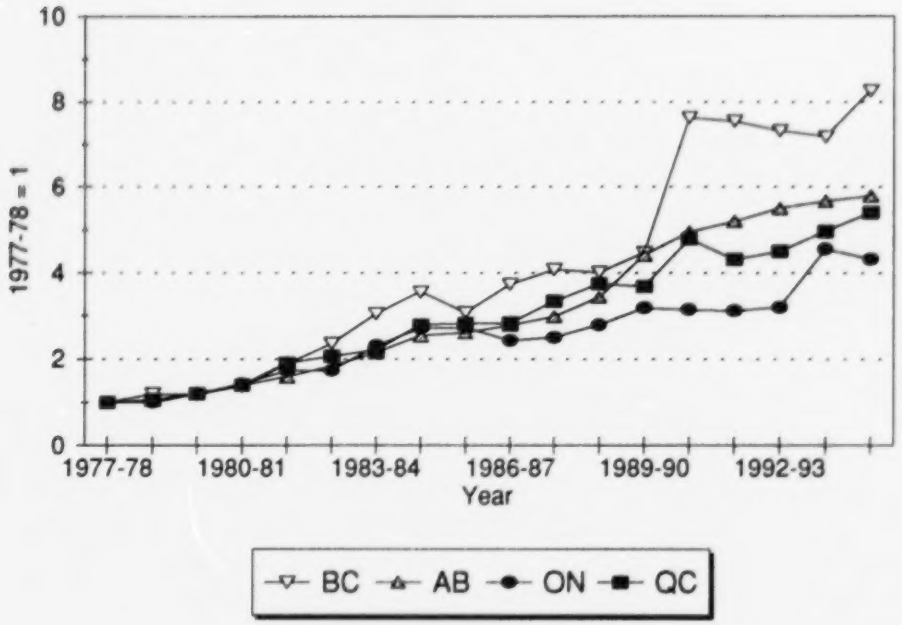
Figure 4



The Medical Research Council (MRC) and the Social Sciences and Humanities Research Council (SSHRC) also represent significant funding sources for research in Canadian universities, respectively for biomedical and health, and humanities and social sciences research. **Figure 5** shows the growth of MRC funding and **Figure 6** the growth of SSHRC funding, both of which have been slower in Ontario than in the other three provinces. The data also show that the relative share of MRC funds captured by Ontario university researchers has decreased from 38% in 1979-80 to 34% in 1994-95. Likewise, the relative share of SSHRC funding has decreased from 52% to 35% over the same period, whereas Québec has increased its share from 23% to 36%.

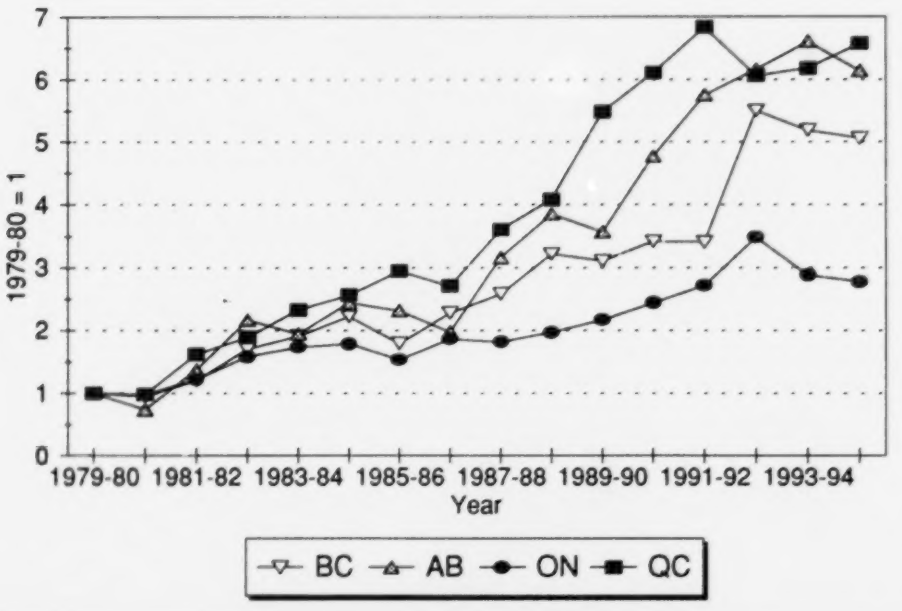
MRC Funding

Figure 5



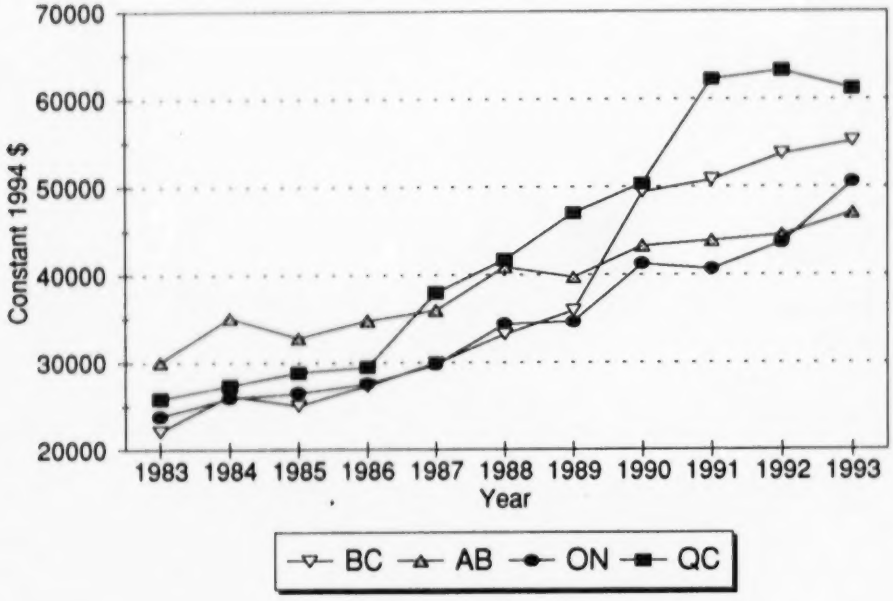
SSHRC Funding

Figure 6



Sponsored Research by Academic Staff

Figure 7



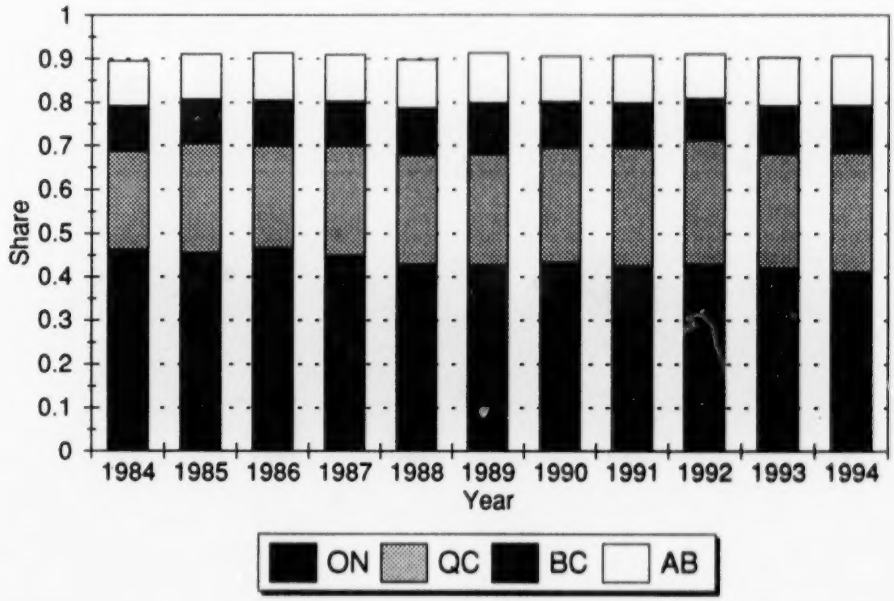
People are the essential element of research capability, which means their intellectual capacity — regardless of the research system used — has to be assessed. However, there is no accurate information on trends in the number and quality of university researchers (and in funding per researcher). The number of university teachers (another Statistics Canada database) was used as a proxy for the number of researchers. **Figure 7** shows research funding per academic staff.

Trends in the number of research master's and doctorate degrees conferred also provide an indicator of research capability. **Figure 8** shows that other provinces are catching up with Ontario in terms of the share of PhDs granted.

Section 5 of the Appendix presents a more detailed analysis of the situation and, where applicable, provides figures that include not only trends but also actual numbers.

Provincial Share of PhDs Granted

Figure 8



4. MAJOR CHALLENGES

The data presented in the preceding sections show that Ontario is losing ground. For example, Ontario universities now receive slightly less from federal granting councils than they would if the allocation were based on population rather than on peer review. This is a dramatic turnaround from the '60s and '70s.

These are worrisome trends, but it is important not to lose sight of the complete picture. Ontario universities still perform close to 40% of university research sponsored in this country (the province's population share is 37.5%), and they are particularly successful in obtaining private

support for their research. There are excellent researchers doing high quality and relevant research in Ontario, and medical research is thriving in numerous institutes.

Universities in this province, the country's largest and richest, should strive at being the best, and ensure that their researchers remain at the forefront of international science at a time of drastic reductions in public funding. Although university research in Ontario is still healthy, according to observers of the research scene, data shows that its health is deteriorating and in need of immediate attention. It is essential to take action now to help reverse this trend and, by doing so, reap the benefits of the judicious investments made in the late '60s and early '70s.

Building an excellent and effective research capacity takes time. Maintaining it requires continuing investment and adjustment.

The individuals interviewed for this study stressed the importance of cohesive provincial and federal policies in support of research, but, above all, they stressed the need for strong institutional leadership. In today's climate, only institutions that can make choices and capitalize on their strengths will be able to sustain a healthy research enterprise. In this regard, it is important to mention that the focus of this study is provincial systems, not individual institutions. Therefore, it masks the fact that, in each of the jurisdictions studied, some institutions are in a much better position than others to weather the economic storm and emerge stronger and better.

4.1 Research Infrastructure

There is no question that Ontario universities have difficulties in supporting and maintaining their research infrastructures, both intellectual and material. This is a major problem for the universities in this province. When the four provinces were compared, Ontario universities were found to have less research infrastructure than universities in the three other provinces. The lack of explicit provincial recognition of the university research mission appears to be the root of the problem.

The situation is not unlike that of Alberta a few years ago, when the various incarnations of the Department of Education had never clearly spelled out what was expected of university research and the province's role in funding its infrastructure. Solutions are now being developed and, although it is far too early to predict whether or not the new measures will be successful, Alberta is a model that Ontario should watch closely.

The situation in Ontario is in sharp contrast with Québec where the Ministry of Education recognized early on and explicitly supported incentives that encouraged universities to develop research and focus their efforts in areas of core strengths.

In fairness to the Ontario Government at the time, research was recognized in the province when the funding formula was introduced in the late '60s. However, after numerous downward adjustments to the basic income unit, the introduction of the corridor system and

the promotion of accessibility, the research component of the funding formula has been weakened and has become much less visible, to both the government and the universities.

The situation in British Columbia is not unlike that which existed in Ontario in the '80s: a strong research capacity and a provincial government that supports applied research and technology transfer but does not explicitly support research infrastructure (a notable exception is infrastructure for federal Networks of Centres of Excellence).

4.2 Federal and Provincial Responsibilities

The correlation between operating grants and research seems to have disappeared (or weakened) as early as 1977 — when federal-provincial arrangements for funding universities were modified. This leads to another aspect of the problem: the undefined federal and provincial responsibilities in the area of research support.

In the first decades of research development in this country, Ontario universities were receiving the lion's share of federally sponsored research funding. Ontario university administrators also held influential advisory positions with federal granting councils and departments. For the most part, they saw the federal government as the logical funder of research infrastructure and indirect costs of research.

Looking to the federal government for support worked well as long as both research grants and transfer payments increased with university enrolment. However, the capping of transfer payments, which coincided with increases in enrolment and in granting-council funding, put Ontario universities in a difficult situation. For solutions, they continued to turn to the federal government, which argued that it was contributing to the indirect costs of research through transfer payments.

In fact, Ontario universities were probably the major losers in this deadlock between the two levels of government. This federal-provincial ambiguity led to both overlaps and gaps in research support. For example, as mentioned earlier, both levels of government put in place similar programs to increase the relevance of university research to industry and other users. The federal Networks of Centres of Excellence were modelled on the newly created Ontario Centres, and URIF and NSERC's Research Partnerships Programs had similar goals and objectives. Furthermore, with the exception of the modest Research Overhead Envelope, research infrastructure was not explicitly supported through the university funding formula.

In contrast, the Québec Government developed, in consultation with universities, programs intended to complement those of the federal government. It recognized the link between a strong and healthy university research base and socioeconomic development, and took action to strengthen that link. For example, noting the federal government's priority to individual investigator-driven research, the Québec Government promoted collaboration, thus encouraging universities to build on their areas of strength. This type of program also

encouraged differentiation of institutions based on areas of specialization, not size or functions. To help build the infrastructure for teams, the government provided infrastructure grants to selected research centres, which, increasingly, involve more than one university and promote institutional complementarity.

The recent surge in private research funding makes action even more urgent. Industry is willing to pay for research results, including the indirect costs of contractual research, but not for the infrastructure needed to generate the knowledge on which applied research depends.

4.3 Nurturing New Researchers

People are the essential element of research capability, and the success or failure of any research system depends on its intellectual capacity. With the large number of academic staff taking early or normal retirement, it is imperative to attract and retain exceptional recruits. And with other jurisdictions competing for the same resources, it is necessary to give new academic staff the necessary tools to be successful at both teaching and research. Again, this requires adequate infrastructure. It is not the responsibility of industry to attract high-quality academic staff and to provide them with the space, facilities and basic equipment to start a successful research program.

4.4 Balance Between Publicly and Privately Supported Research

The fact that private sponsors are increasing their support to research funding is good news. However, it also means that universities and their academic staff must adapt to a new reality, one that will no doubt lead to major structural changes in the way research is done. Flexible policies and priority-setting mechanisms will be required for these changes to be effective and productive. And universities that implement strategic plans geared for the new reality will certainly have a competitive edge over universities that simply let things happen.

Researchers who work in areas of interest to private donors or sponsors have — and will continue to have — access to research support from various sources. These researchers, however, must tackle research problems that are more complex, work in multidisciplinary — and often multi-university and multi-sector — teams, and generally meet stricter deadlines and function within shorter time frames. For these academic staff, research becomes more and more time-consuming, which leaves less time for other duties. This new work reality draws on university resources (even if sponsors pay all or part of the indirect costs) and contribute to increasing the tension between teaching and research.

On the other hand, researchers working on projects of less immediate interest to private sponsors will continue to experience difficulty finding external support for their research, which will increase tensions within universities. Yet, many of these researchers contribute to building the essential knowledge base which both targeted research and teaching draw upon. This untapped research capacity is of concern to some of the individuals interviewed for this

study, who stress that infrastructure support must recognize the responsibility of universities to ensure a proper balance among areas of research — not only balance between broad discipline groups but also balance within these groups.

5. A FRAMEWORK FOR ACTION

This section presents a framework for action that would help the Ontario Government increase the benefits of its investments in university research and increase the leverage and visibility of its support for this research.

5.1 A Formal Policy Statement

The first step would be a simple one: a formal policy statement by the Government of Ontario, through its Minister of Education and Training, recognizing that research is a fundamental mission of universities, essential not only for providing a vibrant learning environment for Ontarians but also for contributing to the cultural, social and economic development of this province. In this statement, the government would formally define the role of the Ministry in supporting that mission and spell out what it expects from university research.

The statement would also stress that other ministries are partners of universities, calling on university expertise to become involved in their policy decisions and help them fulfil their mission.

5.2 Explicit Support for Research Infrastructure

The original funding formula recognized research in several ways. First, the calculation of the basic income unit took into account the full costs of academic salaries as well as the space and facilities needed for academic functions. In addition, the costs of research were recognized specifically through the differential weights assigned to graduate students in all disciplines. As mentioned earlier, numerous adjustments to the formula over the years have weakened the support of research through provincial grants, with the exception of the modest, but welcome, Research Overhead Envelope.

The Research Overhead Envelope should be enhanced and renamed Research Infrastructure Support.

The Envelope could be modelled on the formula used in Québec: The base should encompass not only grants from the federal granting councils, but also all peer-reviewed research grants as an incentive for universities to seek diversified funding sources. Although the percentages

used in Québec are low — 10% for biomedical research and 15% for other disciplines — given the current fiscal reality, they would be an adequate starting point.

As an incentive to seek industrial support and to develop a research environment receptive to industrially oriented research, a small component of the Envelope could be based on the amount of industrial funding received by university researchers.

As is the case in Québec, another small component could be based on the number of research graduate degrees conferred — as opposed to enrolment — to stress outcomes rather than input.

5.3 Attracting and Retaining New Faculty Members

The large number of retirements in Ontario universities provides these institutions with an opportunity to recruit new professors in areas of high priority. However, a competitive package is required to attract and retain excellent new staff. For these young recruits, this means well-equipped space (or library materials) to enable them to start their program quickly and to be successful in obtaining external funding. Alberta recently launched a program aimed at helping universities attract new faculty in priority areas by providing funding for space, equipment and facilities. Québec has had a peer-reviewed program for several years whereby new faculty can obtain operating grant support (with some equipment) to help launch a research program and become more competitive in national programs.

The Government of Ontario should launch a program modelled on Alberta's, which, at this point, appears more appropriate for Ontario universities. Given fiscal restraints, consideration could be given to a program that would match private-sector donations.

This proposed program implies that each university has clear research priorities that build on its own strengths.

5.4 Harnessing University Expertise for Socioeconomic Development

The Ontario Centres of Excellence program is this province's major instrument for increasing the economic impact of university research. Its success has been proven, although other models, too, have been successful.

In renewing Ontario's technology policy, the Ministry of Economic Development, Trade and Tourism should look at other smaller-scale mechanisms as a complement to the Centres of Excellence program. A relatively inexpensive but effective model is that of Québec's Centres de liaison et de transfert, whereby a broker organization in a sector helps bring together industry and university partners to tackle pre-competitive research problems. Seed funding to promote the creation of such organizations in selected sectors could be considered. Some

Centres could also be supported on a local or regional basis, with contributions from other levels of government, as is already the case in some Ontario regions.

5.5 Complementarity with the Federal Government

An effective research development policy requires that all levels of government pursue similar and compatible objectives.

In expanding the Infrastructure Envelope and promoting initiatives to support new faculty and programs aimed at strengthening contributions of university research to economic development, the Ontario Government should ensure that its actions are complementary to those of the federal government and are effective in leveraging federal government support. In all cases, the option of shared programs with the federal government should be actively pursued.

5.6 Ontario Universities: A Network of Complementary Institutions

Universities, in collaboration with the Ministry of Education and Training, should develop performance measures for university research and monitor progress against these indicators on a regular basis. Each institution would have its own performance objectives in line with its specific research mission. The fact that each institution has a different research mission should be recognized. Differentiation has been discussed for years in Ontario. However, it is a word that often has a pejorative connotation or is interpreted as "Bigger means better." In the present context, "different" simply means that each university has its own priorities and areas of strengths recognizing its unique environment and clientele.

6. CONCLUSION

In this study, a review of research development polices in selected provinces, combined with an analysis of trends in selected indicators of research performance, has revealed that provincial policies have a major impact on the success and competitiveness of university research.

Other provincial governments have placed a high priority on university research development, and their course of action has been successful. Trends indicate that universities in those provinces have increased their research performance at the expense of Ontario universities, where low infrastructure support makes it difficult to sustain a healthy research enterprise.

This paper proposes a framework for action. If adopted, this framework would help Ontario universities regenerate their research infrastructure in priority areas of their own choosing. As

well, it would increase the contribution of universities to the wealth and well-being of Ontarians and Canadians.

Cohesive provincial policies provide an essential ingredient of success but only if implemented by strong institutional management. In this current economic climate, only institutions that can make choices and capitalize on their strengths will be able to sustain a healthy research enterprise. This report studied provincial university systems, not individual institutions. The results mask the fact that, in each of the jurisdictions under study, some institutions are in a much better position than others to weather the storm and emerge stronger and better. Implementing the proposed framework would heighten the contributions of these institutions to the socioeconomic success of both Ontario and Canada.

7. HIGHLIGHTS OF RESEARCH POLICIES IN QUÉBEC, BRITISH COLUMBIA, ALBERTA AND ONTARIO

Québec

- Québec has had structured scientific development policies for over 25 years.

- Prior to then, Québec's scientific capacity was lagging well behind that of Ontario and many other provinces. Medical research was strong, but science and engineering were underdeveloped, with the exception of McGill University.

- In the first 10 to 15 years of Québec's science policy (1970s), universities were the main instrument of research development.
  - Policy was based on the conclusion that the first step should be the development of an adequate pool of highly qualified research personnel.
  - Full-fledged granting councils were created.
  - Effort was directed at:
    - building critical mass in the various disciplines
    - ensuring complementarity with federal granting councils
    - promoting team research as opposed to individual research

- As a result, Québec universities have raised their share of granting council funding, leveraging federal funds on the basis of excellence.

By promoting collaboration and teamwork as a means to build on strengths, Québec gave its researchers a competitive edge, especially now that the team approach is seen as an essential means for solving many difficult research problems.

British Columbia

- British Columbia has had a formal science and technology policy since 1988.
- The policy was developed by the Premier's Advisory Council on Science and Technology (PACST).
- Responsibility for implementation and coordination now rests with the Science and Technology Branch of the Ministry of Employment and Investment (MEI); prior to 1993, it rested with the Ministry of Advanced Education, Training and Technology.
- The Science Council of British Columbia, also under MEI, has a key role in:
  - delivering the science and technology policy
  - supporting targeted university research and training
- B.C.'s science and technology policy:
  - recognizes research as an instrument of economic development
  - recognizes the role of postsecondary institutions in applied research and technology transfer
  - includes a strong public awareness component
  - includes a high-profile awards program
  - focuses on the establishment and growth of outstanding research, on collaboration and on facilities
  - encourages applications and commercialization
  - is linked to specific programs to support the objectives

Alberta

- Alberta's policies and programs in all areas have experienced major changes in recent years, since the province embarked on a major deficit cutting exercise.
- The main responsibility for science is with the Alberta Science and Research Authority (ASRA), created in late 1994:
  - with jurisdiction over the science and technology budgets of line departments and agencies
  - which determines the province's research priorities, following a public consultation
- About one-third of provincial government research expenditures are invested in university research.
- Prior to the creation of ASRA, the Department of Advanced Education and Career Development (AECD), and its previous incarnations, had never explicitly recognized university research.

- Recent efforts at consolidating Alberta's research policy triggered AECD's interest in clarifying its role regarding university research and led to a wide consultation, culminating in the Cloutier report. Its principal findings were:

    - The recruitment and retention of exceptional researchers is becoming a serious problem.
    - There is a drastic reduction in infrastructure resources.
    - The indirect costs of research may be eroding resources for the teaching infrastructure.
    - There is a need to recognize that university research exists and that it needs a spokesperson at the Cabinet table.

- A policy framework, *Fostering Excellence*, was adopted in 1996. The framework addresses many of the concerns of the Cloutier report. As such, it:

    - Provides $6 million over the next three years to help universities establish newly recruited researchers.
    - Emphasizes public accountability, with measures of quality and relevance established for university research. The funding formula will be partly based on performance, and indicators of research performance are being developed. They include research intensity (sponsored research as a fraction of operating budget); research graduate student enrolment and graduate student awards; publications and their impact (e.g., citations); granting council grants; private funding of research; licensing revenues; and invention disclosures.

AECD also defined its expectations of university research. Universities are expected to:

- reinforce areas of excellence or strength
- increase partnerships and strategic alliances
- strive for quality in both research and teaching
- be accountable and responsive

Ontario

- Responsibility for science, research, innovation and technology has not been clear, moving from Cabinet Office, to Natural Resources, to Premier's Council and to successive incarnations of the Ministry of Industry or Economic Development, with some sharing of responsibility with Education and line departments.

- Prior to the mid '80s, the various incarnations of the Ministry of Education and Training were not very active in explicitly promoting university research and scientific development.

- At that time, university research flourished in Ontario because:
  - It was relatively well funded by the federal granting councils.
  - The operating grants formula, through its differential weights for graduate students, helped pay for the expansion of graduate studies and the indirect costs of research.
  - Capital funding was available for expansion of research space.
  - Federal policies were serving Ontario well, greatly contributing to the development of a strong research infrastructure.

- In the absence of financial constraints, explicit university research development policies were not needed at the provincial level.

- The turning point for infrastructure funding came in the early '80s when both enrolment and sponsored research funding, especially from the federal government, grew at a much faster pace than operating grants funding.

- Research infrastructure envelope was introduced in 1987 (originally 15% of federal granting-council funding, but decreased to 12.4 % in 1994-95).

- Ontario, like many other jurisdictions, developed innovation policies and programs starting in 1984 to harness the fruits of university research, which led to the creation of the Ontario Centres of Excellence and the University Research Incentive Fund.

To improve its competitiveness, Ontario needs to adopt a framework of action:

- Develop a formal policy statement on research.
- Explicitly support research infrastructure.
- Devise means to attract and retain new faculty members of the highest calibre.
- Harness university expertise for socioeconomic development.
- Devise programs that are complementary to those of the federal government.